FROM THE GROUND UP

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AGRONOMY NEWS

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MILLET PRODUCTION

As the wet weather continues and the optimum planting window for corn passes, producers are beginning to consider alternate crops for the upcoming season. Millets may provide a suitable choice as they can be planted beyond June 1 and still produce acceptable grain yields. The millets grown world-wide are important as feed and food sources. During 1965 to 1985, millet production has varied between 35,000 and 210,000 harvested acres in Colorado. Only two types are common in Colorado: proso and foxtail. Proso grain can be used for livestock consumption, but is more typically sold in bird seed mixtures. Foxtail is mainly grown for hay production, but grain is also marketed as bird seed.

Proso is a short season crop requiring 50 to 90 days from seeding to maturity for early to mid-season varieties. Foxtail millet requires 55 to 70 days to reach a suitable stage for hay and 75 to 90 days for grain production.

Both types of millet require relatively warm weather for germination and plant growth. Optimum soil temperatures for seed germination are between 68° and 86°F. Even under favorable conditions, millet grows slowly the first few weeks after planting.

Both millets are usually grown under dryland conditions. However, some growers produce millet under irrigated conditions. Millet is a shallow rooted crop and will extract most of its water and nutrient requirements from the top three feet of the soil profile, but it can extract water from greater depths.

The best planting date for millets can vary greatly with circumstances. Proso can produce a good seed crop when planted as early as May 15 or as late as July 1. Research at Akron, Colorado, using the full season variety Cope, has shown June 8 to be the optimal planting date, with 95% of yield potential obtained between June 2 and June 12.

The equipment used to seed millet is usually dictated by equipment available for other crops such as wheat. Research has shown that narrow rows (6 inches) enhance yields and minimize weed competition as compared to wide rows (12 inches). Many drill types will work including deep furrow, double discs types, and no-till drills. Research has shown that choice of drill has little effect on yield production of millet if good seeding management is practiced. The main goal should be to cover seed with no more than an inch of firmly packed soil.

Atrazine is no longer available for use in proso, and the use of it can place the crop in jeopardy of condemnation.

Proso millet has approximately 80,000 seeds/lb. Seeding rates of approximately 8 to 15 pounds per acre are recommended for dryland conditions and 25 to 30 pounds per acre for irrigated conditions. When planting in poor seed beds and under heavy expected weed pressure, higher seeding rates should be used. Foxtail millet contains approximately 220,000 seeds per pound and should be planted around 6 pounds per acre.

Weeds can be a serious problem in millet. There are three basic weed control strategies: 1) non-chemical, 2) in crop herbicide use, and 3) preplant herbicide burndown followed by in-crop herbicide use. It should be noted that atrazine is no longer available for use in proso, and the use of this herbicide can place the crop in jeopardy of condemnation. Strategy one can sometimes be accomplished by delaying millet planting into warm soils (typically after June 10), encouraging rapid millet growth and weed competition.

Regarding strategy 2, only 2,4-D amine and dicamba (Banvel) are labeled for in crop use for broadleaf weed control in millets. Glyphosate (Roundup) could be used for preplant burndown purposes. As always, check with your agrichemical supplier regarding label specifications.

Although fertility requirements of millets are not high, it is generally recommended that 40 pounds per acre of nitrogen be applied when millet follows wheat. If fallow precedes millet, nitrogen fertilizer may not be required. This recommendation can be fine tuned by taking a soil sample and determining residual nitrogen in the soil. Apply nitrogen with discretion to foxtail millet to avoid excessive nitrates accumulation in the forage. Phosphorus is the second most limiting nutrient in Colorado. Application rates should be based on soil test recommendations. In row phosphorus fertilization gives the best response per unit of fertilizer applied.

The suggested method of harvesting proso is swathing when the seeds in the upper half of the panicle have matured and combining. Seeds in the lower half may still be in the soft dough stage, but should have lost their green color. This practice will maximize yields and minimize grain shattering. Foxtail millet for hay should be harvested in the late boot to bloom stage to maximize forage quality. Foxtail millet for grain production should be swathed when the head is fully ripe and combined after drying. ▫Shanahan

COLLABORATIVE ON-FARM TESTING

On-farm testing is not new. Early records show that on-farm testing was used back in the late 1800's at Hays, KS. Collaborative on-farm testing (COFT) is sometimes referred to by different names, including on-farm research, drill-strip testing, participatory on-farm testing, or Extension demonstration plots. I am using the term 'collaborative' because COFT depends on collaboration among growers, Extension agents, seed dealers, university researchers, and private seed companies. COFT formalizes a common testing process already practiced by many growers - get some seed of a new or different variety and put it out on a small patch of land to see how it does by comparison to the variety grown on the rest of the farm. The COFT system enriches this individual farm approach by networking growers together who share common agroclimatic conditions. The theory behind spatial networking is that agroclimatic conditions on a farm this year may not reflect the climatic conditions for the coming year. Another farm which is 20 or 50 miles away may be experiencing the climatic conditions this year that will occur on the first farm in the coming year. Spatial networking with the same varieties in drill-strips at multiple farms permits us to average crop variety response across a set of actual farm conditions to improve the predictability of variety response in the coming year. On-farm test results are usually favored by producers because the tests are conducted under more real farm conditions, in large plots or strips, and using actual farm equipment. Economic analyses of alternative technologies is more reliable from on-farm data. CSU hopes that COFT will more actively engage our collaborating growers, agents, and company reps in the testing process to speed the identification and adoption of superior new varieties.

Spatial networking with the same varieties in drill-strips at multiple farms permits us to average crop variety response across a set of actual farm conditions to improve the predictability of variety response in the coming year.

Objectives of Collaborative On-Farm Testing

1. Identify improved wheat, corn, sunflower, and bean cropping practices (including varieties) that are economically beneficial.

2. Give better feedback to researchers for fixing research priorities that better reflect the felt-needs of producers.

3. Study agronomic research questions which are more effectively or more efficiently answered in farmers' fields than on research stations.

4. Training:
'First look' at new varieties by producers, Extension agents, and seedsmen.

Keeping researchers up-to-date with real production problems.

5. Define predictively reliable agroclimatic zones for each crop.

1995-96 COFT of Russian Wheat Aphid (RWA) Resistant Winter Wheat

Description

Compare RWA resistant Halt to higher yielding TAM-107 on about 40 farms to determine the levels of RWA infestation where it is economically advantageous to plant Halt instead of TAM-107. Collaborating farmers would be recruited from counties with the highest risk of RWA infestation: Baca, Prowers, Kiowa, Cheyenne, Lincoln, Adams, Arapahoe, and Weld counties. Collaborating producers would be asked to plant and harvest a drill strip of each variety in a winter wheat field considered susceptible to

1995-96 COFT:

Compare RWA resistant Halt to higher yielding TAM-107 on about 40 farms to determine the levels of TWA infestation where it is economically advantageous to plant Halt instead of TAM-107.

RWA attack. Each collaborator would receive one bushel of seed of each variety and each drill strip should be wider than the width of the combine header that would be used to harvest the strips. The producer would be expected to weigh the production from each strip and labeled sacks would be provided to collaborators to collect a grain sample from each variety at the time of harvest.

CSU Crops Testing will coordinate the testing activities, procure and distribute seed, provide brief instructions on how to conduct the test, analyze data, and report test results. Extension entomologists have volunteered to survey the tests periodically to determine levels of RWA infestation. It is hoped that county Extension personnel will coordinate test activities within each county which would entail recruitment of collaborating producers, assistance to producers as needed for planting and harvesting, and compilation of test data on a county level.

Interested producers, county Extension personnel, or seedsmen should contact your local county agent, Jerry Johnson (new Extension specialist for crop production), or John Shanahan at CSU: (970) 491-1454 or e-mail Jerry at jjj@lamar.colostate.edu.
▫Johnson

POST-PLANTING MANAGEMENT OF DRY BEANS

Many producers have had to delay planting dry beans this year due to wet soil conditions. The wet conditions may have prevented incorporation of preemergence herbicides, consequently weeds may become a problem. Three herbicides are labeled for postemergence use on dry beans. They are Basagran, Pursuit,and Poast; however, each herbicide controls a different set of weeds and has restrictions for use. If you choose to use one of these herbicides, consult your herbicide specialist and follow label directions.

Cultivation of seedling bean plants can also control weeds, break soil crusts, and improve soil aeration. Cultivation operations can be used to make furrows or ridges to facilitate irrigation. Early season cultivation should minimize soil disturbance between the rows and mazimize the benefits of any preemergence herbicide that may have been applied. All field operations should be avoided when the soil or the bean plants are wet to prevent soil compaction and minimize the potential spread of foliar pathogens by machinery.

Post-planting ripping may be necessary if soil compaction occurred during field operations. Soils that are compacted will have reduced water infiltration rates, a shallow root zone, and increased problems with root pathogens and white mold disease. Ripping or deep chiseling improves soil aeration, reduces soil compaction, and can increase yield. A 3 year study at Colorado State University showed that on compacted soil, yield was increased 20% by ripping. Post-planting ripping should be conducted in relatively dry soil to ensure that the chisel points break up the compacted layer rather than slice through it. Chisels or knives used for ripping should avoid plant roots to prevent root injury and predispose the plant to soil borne pathogens. ▫Brick

Congratulations to Kathryn Apley, Gary Peterson, Reagan Waskom, and Dwayne Westfall in the Department of Soil and Crop Sciences for passing both the national and [illegible] CCA exams and becoming Certified Crop Advisers.

Bruce Bosley, Extension Agent from Morgan County, also passed these exams and is now a Certified Crop Adviser.

USING GYPSUM OR SULPHUR FOR RECLAIMING SODIC SOILS

Reclaiming sodic soils (soils high in sodium) may require the addition of gypsum or sulphur along with irrigation water. Gypsum ($CaSO_4$ 2 H_2O) should not be confused with lime ($CaCO_3$), which is needed to raise the pH of acid soils. To evaluate whether a soil is sodic, it is necessary to analyze for pH, electrical conductivity (EC), and sodium adsorption ratio (SAR) or exchangeable sodium, cation exchange capacity (CEC), and exchangeable sodium percentage (ESP). If a soil has a pH (on a paste basis) of 8.5 or more and the EC is less than 4 *mmhos/cm*, it is considered sodic. If the soil has an EC of more than 4 *mmhos/cm* and a pH greater than or equal to 8.5, it is considered saline/sodic. Generally the EC of the soil is determined from the paste extract of the soil. The paste extract is poured into the EC cell and the EC is then measured. The paste extract is then analyzed for calcium, magnesium, and sodium and an SAR is calculated. If the SAR is greater than or equal to 15, then the soil is considered a sodic soil that may need reclamation.

If a sodic soil needs to be reclaimed, a gypsum or sulphur requirement is needed. The gypsum or sulphur requirement is based on how much gypsum is needed to bring the ESP to 10% versus how much gypsum is already in the soil. Sometimes there is enough gypsum already in the soil and all that is needed is to add good quality irrigation water to start dissolving the gypsum. The calcium from gypsum exchanges with the sodium on soil exchange sites and the sodium gets flushed out of the soil if there is good drainage. If there is not adequate gypsum already in the soil compared to what is needed, then additional gypsum or sulphur needs to be added.

An alternative method of determining whether a soil is sodic is to measure exchangeable sodium and either estimate or measure CEC. Exchangeable sodium divided by CEC times 100 equals ESP. Again, if the ESP is greater than or equal to 15, then the soil is sodic. The amount of gypsum or sulphur required can be determined by calculating the amount of excess sodium that needs to be removed from the soil to reach an ESP of 10%. In calculating excess sodium, it is first necessary to calculate the amount of sodium required for a 10% ESP at the soil's CEC:

$$\frac{\text{Exchangeable Na}}{\text{CEC}} = 10\%$$

Once the required exchangeable sodium is obtained, then it can be subtracted from the total amount of exchangeable sodium to find out how much sodium is in excess. Table 6 in USDA Handbook 60 (Diagnosis and Improvement of Saline and Alkali Soils) shows how much gypsum or sulphur must be added relative to the amount of excess exchangeable sodium.

Although gypsum is an acceptable amendment for reclaiming soil, it may be hard to obtain. An alternative is to use sulphur. For every ton of gypsum needed, only about 0.2 tons of sulphur is required. Sulphur is available at most fertilizer dealers and is usually less expensive than gypsum. Sulphur acts by being converted to sulphate and then the sulphate reacts as sulfuric acid with alkaline earth carbonates to produce a soluble form of calcium. The calcium exchanges with sodium on the soil exchange sites and the sodium can be flushed out with irrigation water. Sulphur reacts slower than gypsum since it must first be oxidized by microbial action to sulphate. One ton of sulphur per acre is usually oxidized in about 2 to 3 weeks under favorable soil moisture and temperature conditions.

Although a total amount of recommended sulphur or gypsum is determined, it is usually more acceptable to suggest adding one-fourth to one-third of the amendment each year. Adding smaller portions each year will demonstrate whether the remediation process is working without excess expense. Reclaiming sodic or saline/sodic soils also depends on whether there is good quality irrigation water available and whether there is adequate drainage. ▫Self

GROUND WATER MONITORING IN THE ARKANSAS RIVER BASIN

We continue to receive more ground water monitoring data for the state of Colorado. For the most part, the information is encouraging, especially when compared to data from other agricultural states. This past year, the Colorado Department of Public Health and Environment monitored ground water quality in one of Colorado's major agricultural regions, the Arkansas River Valley. They sampled 139 domestic, stock, and irrigation wells throughout the valley during the summer and fall of 1994.

Laboratory analyses indicate that ground water in some areas of the valley has been impacted by agricultural chemicals. The major contaminant of concern is nitrate. Nineteen of the 139 (14%) wells sampled showed nitrate levels in excess of the EPA standard for drinking water (10 ppm NO_3-N). The majority of the wells that exceeded the nitrate standard were located in Otero County. Twelve of the 139 (9%) well samples tested positive for the herbicide Atrazine. One well contained traces of the herbicide Metolachlor, and one contained the herbicide 2,4-D. All pesticide detections where well below the drinking water standard.

The Arkansas Valley sampling program was the first effort to screen the entire shallow aquifer to establish the possible impacts and magnitude of agricultural chemical contamination. The Arkansas Valley is characterized by intense irrigated agriculture encompassing both surface water diversions and large capacity irrigation wells for irrigation water supplies. The wells supply surface and center-pivot irrigation systems from the shallow unconfined aquifer. This shallow aquifer is also a significant source for domestic and municipal water supplies throughout the valley.

Given the long history of irrigated crop production in the valley, we expected to see greater impacts from ag chemicals. By far, the most significant water quality problem was excess salts. The mean value for total dissolved solids (TDS) in the alluvial aquifer was 2,359 ppm, with the range from 365 to 5,540 ppm. Drinking water quality is generally considered to be compromised at 500 ppm TDS and will have a noticeable off-taste at 1000 ppm. Sulfate salts of geologic origin were the major source of TDS, which tend to give Arkansas Valley drinking water its characteristic taste.

Summary of Water Quality Data

Pesticides	% of wells with detections	% exceeding Drinking Water Standard
Atrazine	8.6	0
Metolachlor	0.7	0
2,4-D	0.7	0
Inorganics		
NO_3-N	93.5	13.7
TDS	100.0	98.6 (>500 ppm)

▫Waskom

AGRICULTURE ALSO OFFERS SOLUTIONS TO NITRATE PROBLEMS

It's common to hear of how water quality problems are created by agriculture, but how often do we hear of how agriculture can improve water quality? Nitrate contamination of groundwater is one of the biggest water quality problems in Colorado. Fortunately, agriculture can help remove NO_3 from surface or ground water if producers adjust their fertilizer rates to credit N in irrigation water. This is one BMP that all Colorado irrigators can take advantage of with little or no additional cost and no loss of crop yield.

Irrigation water containing nitrate can supply N to the crop since it is applied and taken up as the crop is actively growing. Water tests for NO_3-N should be taken during the irrigation season to accurately calculate this credit. Multiply ppm NO_3-N by 2.7 lbs/acre ft. times the amount of irrigation water consumptively used by the crop (in AF) to determine lbs N/acre applied. Be aware that irrigation water that runs off the field or deep percolates below the rootzone should not be included in this calculation. If you are hesitant to use this practice on all of your acres, try decreasing N fertilizer by the appropriate amount on whatever portion of a field you feel comfortable with, and evaluate the yield response at the end of the growing season.

Even if you have already applied all of your N fertilizer for this season, the summer is the time to get a water sample analyzed so you can determine the appropriate N credit for next year. Most labs provide NO_3-N water tests routinely. Some producers may be able to take advantage of tests offered free by water districts and other local organizations, or there are several inexpensive quick tests kits available for on-farm water testing. The Hach company in Loveland is an excellent source of reliable field test kits for NO_3 analysis.

Example Calculation:

Irrigation water N credit

20 inches of effective irrigation containing 10 ppm NO_3-N = ? lb N/A

$$\frac{20 \text{ inches irrigation/A}}{12 \text{ inches/AF}} \times (2.7 \text{ lbs N/AF}) \times (10 \text{ ppm } NO_3\text{-N}) = 45 \text{ lb N/A}$$

Some producers feel more comfortable using table values rather than calculations. The following table can be used to determine an appropriate N credit. Be sure that your water analysis is reported as NO_3-N, not NO_3, or your calculation will be off by a factor of 4.4. Also, remember that the effective rootzone of a crop like onions is much more limited than deep rooted crops like corn, generally resulting in lower irrigation efficiencies. Therefore, it is important to estimate crop specific NO_3 credits so that yield is not limited due to lack of N. The actual dollars saved by accounting for N in irrigation water may not make a huge difference in your net profit, but you can take credit for helping to improve water quality while sustaining high yields.

N credit from irrigation water

	Effective Irrigation ------ Acre inches ------					
	6	12	18	24	30	36
NO_3-N conc. in water (ppm or mg/L)	------ lb N credit/A ------					
2	3	5	8	11	14	16
4	5	11	16	22	27	33
6	8	16	24	32	41	49
8	11	22	32	43	54	65
10	13	27	40	54	67	81
12	15	32	48	65	81	97
14	18	37	56	76	95	113
16	21	42	64	87	109	129
18	24	47	72	98	123	145

▫Waskom

ANNUAL AOSCA MEETING A SUCCESS

The Colorado Seed Growers Association (CSGA) hosted their 1995 meeting of the Association of Official Seed Certifying Agencies (AOSCA) from June 4-8 in Colorado Springs. Over 225 delegates and family members attended.

One of the business items that was handled by the Association was to streamline methods to include foreign countries into the AOSCA scheme of seed certification. Countries currently using AOSCA methods include Canada, New Zealand, and Argentina. Bangladesh, Mexico, and several other countries have expressed interest.

CSGA wishes to express their gratitude to businesses and individuals who donated money, products, or their time to make the endeavor a success. ▫Stanelle

Where trade names are used, no discrimination is intended, and no endorsement by the Cooperative Extension Service is implied.

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Sincerely,

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